

# Dense and randomized storage and coding of information

## Abstract

We describe a method for dense encoding of information. Bennett and Wiesner (Phys. Rev. Lett. 69:2881–2884, 1992), using EPR-pairs, showed that  $n$  bits can be encoded by  $n/2$  quantum-bits, from which the original bits can be retrieved. Here, in a completely different (non-quantum) setting, we give a method for more dense encoding: In our method  $n$  bits  $x_1, x_2, \dots, x_n$  are mapped by a linear transform  $B$  over the 6-element ring  $Z_6$  to numbers  $z_1, z_2, \dots, z_t$  from ring  $Z_6$  with  $t=n^{o(1)}$  (i.e., much fewer numbers) (Quantity  $o(1)$  here denotes a positive number which goes to 0 as  $n$  goes to infinity), then, by applying another linear transform  $C$  to these  $z_i$ 's, we will get back  $n$  elements of ring  $Z_6$ ,  $x'_1, x'_2, \dots, x'_n$ , where, e.g.,  $x'_1$  may have the form  $x'_1 = x_1 + 3x_2 + 4x_3$ . One can get back  $x_1$  simply by running through the values of  $x_i$  on the set  $0, 1, 2, 3, 4, 5$ , and noticing that only  $x_1$  has period 6, ( $3x_2$  has period 2,  $4x_3$  has period 3). Our results generalize for any non-prime-power composite number  $m$  instead of 6. We also apply this method for fast computation of matrix multiplication and

for compacting and extending matrices with linear transforms.